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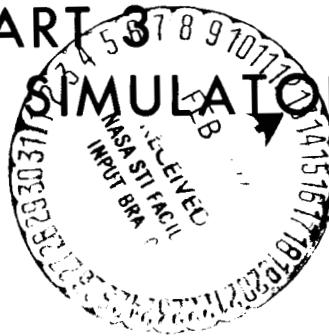
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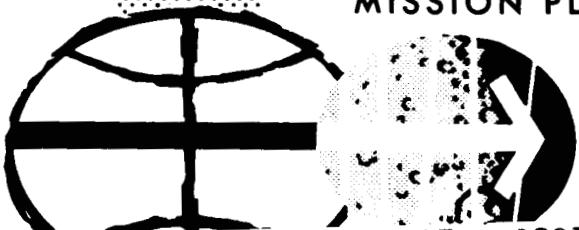
APOLLO MISSION F
(AS-505/CSM-106/LM-4) SPACECRAFT
OPERATIONAL TRAJECTORY, REVISION 1
VOLUME II
TRAJECTORY DATA

PART 3
FLIGHT CREW SIMULATOR DATA



Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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(NASA-TM-X-69427) APOLLO MISSION F

(AS-505/CSM-106/LM-4) SPACECRAFT

OPERATIONAL TRAJECTORY, REVISION 1.

VOLUME 2: TRAJECTORY DATA. PART 3:

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PROJECT APOLLO

APOLLO MISSION F (AS-505/CSM-106/LM-4)
SPACECRAFT OPERATIONAL TRAJECTORY, REVISION 1
VOLUME II - TRAJECTORY DATA
PART 3 - FLIGHT CREW SIMULATOR DATA

By Ron D. Davis and Larry D. Davis
Flight Analysis Branch

May 12, 1969

MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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Apollo Mission F (AS-505/CSM-106/LM-4)

Spacecraft Operational Trajectory, Revision 1

VOLUME II - TRAJECTORY DATA

PART 3 - FLIGHT CREW SIMULATOR DATA

By Ron D. Davis and Larry D. Davis

SUMMARY

The data in this document are compiled to satisfy flight crew and flight controller training and simulation requirements for the F mission. This data pack is based on a F mission operational trajectory, revision 1 (ref. 1). This document contains reset vectors, REFSMMAT updates, navigation updates, navigation checks, detailed maneuver tables, entry data, and associated flight crew data.

INTRODUCTION

The nominal Mission F plan involves the following mission phases

1. Launch, which ends with insertion into earth parking orbit.
2. Earth orbit coast, which ends with TLI.
3. Translunar coast, which ends with LOI.
4. Lunar orbit operations, which ends with TEI.

The prime objective of this phase will be to demonstrate all phases of Mission G except those which directly involve LM powered descent and powered ascent. These operations will include a LM-active rendezvous.

5. Transearth coast, which ends with entry into the mid-Pacific recovery area.

The total mission duration will be approximately 8 days. The data presented in this document were computed by the use of the RTACF processors.

ABBREVIATIONS

AGS	abort guidance system
ALPHA	angle of attack
APS	ascent propulsion system
CD	coefficient of drag
CDH	constant differential height
CL	coefficient of lift
CM	command module
CSI	coelliptic sequence initiation
CSM	command and service modules
cg	center of gravity
DOI	descent orbit insertion
DPS	descent propulsion system
DSKY	display keyboard
EECOM	electrical, environmental, and communications
EL	earth launch
EOI	earth orbital insertion
ER	earth radii
FDAI	flight director attitude indicator
GET GEN	time of data generation
g.e.t.	ground elapsed time
G.m.t.	Greenwich mean time
GMT ID	identification of time
I_{sp}	specific impulse

LES	launch escape system
LGC	lunar module guidance computer
LM	lunar module
LOI-1	lunar orbit insertion
LOI-2	circularization maneuver after LOI-1
PAD	pre-advisory data
RCS	reaction control system
REF	reference body
REFSMMAT	reference to stable member matrix
RTACF	Real-Time Auxiliary Computing Facility
S and S	start and stop
SLA	spacecraft/LM adapter
SM	service module
SPS	service propulsion system
STA ID	station identification
t	time
TEI	transearth injection
TEC	transearth coast
TIGN	time of main engine ignition
TLC	translunar coast
TLI	translunar injection
TPF	terminal phase finalization
TPI	terminal phase initiation
WT	weight
w	flow rate

RESULTS

A set of data that consists of the following is provided for each of the Mission F maneuvers (or entry): reset vectors, REFSMMAT updates, navigation updates, navigation checks, detailed maneuver tables, and other required flight crew data. This data pack supersedes all earlier F mission data packs.

A brief summary of mission-dependent constants used in the generation of this document are presented in table I. A more detailed tabulation of mass properties data can be found in references 2 and 3.

The CSM and LM reset vectors for each maneuver and entry are contained in tables II and III. These vectors are in the mean Besselian coordinate system. This system can be defined as follows: an inertial Cartesian system with origin at the center of the reference body (earth or moon) with the X- and Y-axes in the mean equatorial plane and the Z-axis coincident with the mean polar axis (positive to the north). The X-axis is alined at the intersection of the earth's equatorial plane with the ecliptic at the nearest beginning of a Besselian year.

The CSM and LM REFSMMAT update quantities for the various phases of the F mission are contained in table IV. The required navigation updates for the various maneuver sequences are presented in tables V and VI.

The "detailed maneuver table" quantities for each of the planned maneuvers are presented in table VII. A tabulation of LM gimbal angles converted to LM FDAI angles is given in table VIII. The external ΔV updates for each of the maneuvers are presented in tables IX and X. Additional information in the form of pre-advisory data (PAD) is provided in table XI.

TABLE I.- MISSION-DEPENDENT CONSTANTS

(a) Launch data

Date of launch	May 18, 1969
G.m.t. of launch	16:49:00

(b) Thruster data

SPS steady state

Thrust, lb	20 500
\dot{w} , lb/sec	65.162
I_{sp} , sec	314.60

SPS tailoff -

Burn time, sec	0.59
Thrust, lb	20 847.5
\dot{w} , lb/sec	66.590
I_{sp} , sec	313.07

SM RCS (per quad)

Thrust, lb	102.8
\dot{w} , lb/sec	0.371
I_{sp} , sec	277.09

CM RCS (per quad)

Thrust, lb	96.0
\dot{w} , lb/sec	0.353
I_{sp} , sec	271.95

LM RCS (per quad)

Thrust, lb	100.0
\dot{w} , lb/sec	0.367
I_{sp} , sec	272.48

APS steady-state

Thrust, lb	3 500.0
\dot{w} , lb/sec	11.427
I_{sp} , sec	306.29

APS tailoff

Burn time, sec	0.1
Thrust, lb	2990.0
\dot{w} , lb/sec	9.65
I_{sp} , sec	309.84

DPS onboard (92.5%)

Thrust, lb	9712.5
\dot{w} , lb/sec	32.270
I_{sp} , sec	300.98

DPS (40% level)

Thrust, lb	4200.0
\dot{w} , lb/sec	13.952
I_{sp} , sec	301.03

DPS (10% level)

Thrust, lb	1050.0
\dot{w} , lb/sec	3.488
I_{sp} , sec	301.03

DPS tailoff

Burn time, sec	0.38
Thrust, lb	6503.0
\dot{w} , lb/sec	20.080
I_{sp} , sec	301.44

TABLE I.- MISSION-DEPENDENT CONSTANTS - Continued

(c) Center of gravity computed from weight^a

[CSM propellant on bottom of tanks]

WEIGHT LB	X INCHES	Y INCHES	Z INCHES	PITCH TRIM ^b DEG	YAW TRIM ^b DEG
23200.00	983.59	-2.82	8.01	-3.05	-1.07
25400.00	971.98	-1.61	7.45	-3.07	-0.66
27600.00	962.87	-0.59	6.98	-3.08	-0.26
29800.00	956.14	0.28	6.58	-3.06	0.13
32000.00	951.27	1.02	6.23	-3.02	0.50
34200.00	947.83	1.67	5.93	-2.96	0.84
36400.00	945.61	2.25	5.66	-2.88	1.15
38600.00	944.33	2.75	5.42	-2.79	1.42
40800.00	943.91	3.21	5.21	-2.70	1.66
43000.00	944.15	3.61	5.03	-2.59	1.87
45200.00	944.98	3.98	4.85	-2.49	2.04
47400.00	942.86	4.15	4.90	-2.56	2.17
49600.00	939.03	4.12	5.17	-2.80	2.23
51800.00	936.22	4.09	5.42	-3.01	2.27
54000.00	934.30	4.06	5.65	-3.20	2.30
56200.00	933.17	4.03	5.86	-3.35	2.31
58400.00	932.72	4.01	6.05	-3.48	2.31
60600.00	932.90	3.99	6.24	-3.58	2.29
62800.00	933.62	3.97	6.40	-3.65	2.26
65000.00	934.89	3.95	6.56	-3.69	2.23

[CSM propellant on top of tanks]

23200.00	982.28	-2.58	8.25	-3.17	-0.99
25400.00	981.18	-1.40	7.67	-2.97	-0.54
27600.00	979.27	-0.40	7.18	-2.81	-0.16
29800.00	976.62	0.46	6.76	-2.70	0.18
32000.00	973.41	1.19	6.40	-2.61	0.49
34200.00	969.77	1.83	6.09	-2.55	0.77
36400.00	965.84	2.39	5.81	-2.51	1.03
38600.00	961.63	2.89	5.57	-2.48	1.29
40800.00	957.15	3.34	5.35	-2.47	1.54
43000.00	952.52	3.74	5.15	-2.47	1.79
45200.00	947.72	4.10	4.98	-2.49	2.05
47400.00	947.64	4.18	5.11	-2.56	2.09
49600.00	948.14	4.15	5.38	-2.68	2.07
51800.00	947.91	4.12	5.62	-2.80	2.06
54000.00	947.04	4.09	5.84	-2.94	2.06
56200.00	945.59	4.06	6.04	-3.08	2.07
58400.00	943.66	4.04	6.23	-3.23	2.09
60600.00	941.28	4.02	6.40	-3.39	2.13
62800.00	938.50	4.00	6.56	-3.57	2.17
65000.00	935.70	3.98	6.72	-3.75	2.22

^aThese values are based on reference 2.^bThese angles are measured from longitudinal axis and do not include electronic null bias.

TABLE I.- MISSION-DEPENDENT CONSTANTS - Continued

(c) Center of gravity computed from weight^a - Continued

[LM with APS and DPS propellant on bottom of tanks]

WEIGHT LB	X INCHES	Y INCHES	Z INCHES	PITCH TRIM ^b DEG	YAW TRIM ^b DEG
14000.00	208.60	-0.67	0.58	-0.60	-0.70
14500.00	206.04	-0.65	0.56	-0.61	-0.71
15000.00	203.73	-0.62	0.54	-0.62	-0.72
15500.00	201.63	-0.60	0.52	-0.63	-0.73
16000.00	199.72	-0.59	0.50	-0.63	-0.73
16500.00	197.97	-0.57	0.49	-0.64	-0.74
17000.00	196.38	-0.55	0.47	-0.64	-0.74
17500.00	194.92	-0.54	0.46	-0.64	-0.75
18000.00	193.59	-0.52	0.45	-0.65	-0.75
18500.00	192.35	-0.51	0.44	-0.65	-0.76
19000.00	191.23	-0.49	0.42	-0.65	-0.76
19500.00	190.21	-0.48	0.41	-0.65	-0.76
20000.00	189.27	-0.47	0.40	-0.65	-0.76
20500.00	188.41	-0.46	0.39	-0.65	-0.76
21000.00	187.62	-0.45	0.38	-0.65	-0.76
21500.00	186.92	-0.44	0.37	-0.65	-0.76
22000.00	186.24	-0.43	0.37	-0.65	-0.76
22500.00	185.66	-0.42	0.36	-0.65	-0.75
23000.00	185.14	-0.41	0.35	-0.64	-0.75
23500.00	184.67	-0.40	0.34	-0.64	-0.74
24000.00	184.21	-0.39	0.34	-0.64	-0.74
24500.00	183.85	-0.38	0.33	-0.63	-0.73
25000.00	183.52	-0.37	0.32	-0.63	-0.73
25500.00	183.22	-0.37	0.32	-0.62	-0.72
26000.00	182.95	-0.36	0.31	-0.61	-0.71
26500.00	182.73	-0.35	0.30	-0.61	-0.70
27000.00	182.56	-0.35	0.30	-0.60	-0.70
27500.00	182.41	-0.34	0.29	-0.59	-0.69
28000.00	182.28	-0.33	0.29	-0.58	-0.68
28500.00	182.19	-0.33	0.28	-0.57	-0.67
29000.00	182.15	-0.32	0.28	-0.57	-0.66
29500.00	182.11	-0.32	0.27	-0.56	-0.65
30000.00	182.11	-0.31	0.27	-0.55	-0.64
30500.00	182.16	-0.31	0.26	-0.54	-0.62
31000.00	182.20	-0.30	0.26	-0.53	-0.61
31500.00	181.88	-0.30	0.26	-0.53	-0.61
32000.00	181.52	-0.29	0.25	-0.52	-0.61
32500.00	181.18	-0.29	0.25	-0.52	-0.61

[LM with APS and DPS propellant on top of tanks]

14000.00	213.14	-0.64	-0.90	0.87	-0.62
14500.00	212.13	-0.62	-0.87	0.85	-0.61
15000.00	211.12	-0.60	-0.94	0.84	-0.60
15500.00	210.13	-0.58	-0.91	0.83	-0.59
16000.00	209.13	-0.56	-0.78	0.82	-0.58
16500.00	208.15	-0.54	-0.76	0.80	-0.58
17000.00	207.19	-0.53	-0.74	0.80	-0.57
17500.00	206.23	-0.51	-0.72	0.79	-0.56
18000.00	205.29	-0.50	-0.70	0.78	-0.56
18500.00	204.36	-0.49	-0.68	0.77	-0.55
19000.00	203.43	-0.47	-0.66	0.77	-0.55

^aThese values are based on reference 2.^bThese angles are measured from longitudinal axis and do not include electronic null bias.

TABLE I.- MISSION-DEPENDENT CONSTANTS - Continued

(c) Center of gravity computed from weight^a - Concluded

[LM with APS and DPS propellant on top of tanks]

WEIGHT LB	X INCHES	Y INCHES	Z INCHES	PITCH TRIM ^b DEG	YAW TRIM ^b DEG
19500.00	202.53	-0.46	-0.64	0.76	-0.54
20000.00	201.63	-0.45	-0.63	0.75	-0.54
20500.00	200.73	-0.44	-0.61	0.75	-0.54
21000.00	199.84	-0.43	-0.60	0.75	-0.53
21500.00	198.99	-0.42	-0.58	0.74	-0.53
22000.00	198.12	-0.41	-0.57	0.74	-0.53
22500.00	197.25	-0.40	-0.56	0.74	-0.53
23000.00	196.38	-0.39	-0.55	0.74	-0.53
23500.00	195.56	-0.38	-0.53	0.74	-0.53
24000.00	194.69	-0.37	-0.52	0.74	-0.53
24500.00	193.85	-0.37	-0.51	0.74	-0.53
25000.00	193.02	-0.36	-0.50	0.74	-0.53
25500.00	192.20	-0.35	-0.49	0.74	-0.53
26000.00	191.37	-0.35	-0.48	0.74	-0.53
26500.00	190.53	-0.34	-0.47	0.74	-0.53
27000.00	189.72	-0.33	-0.46	0.75	-0.53
27500.00	188.91	-0.33	-0.46	0.75	-0.54
28000.00	188.09	-0.32	-0.45	0.75	-0.54
28500.00	187.26	-0.32	-0.44	0.76	-0.54
29000.00	186.47	-0.31	-0.43	0.76	-0.55
29500.00	185.64	-0.30	-0.43	0.77	-0.55
30000.00	184.81	-0.30	-0.42	0.78	-0.56
30500.00	183.99	-0.29	-0.41	0.79	-0.56
31000.00	183.58	-0.29	-0.40	0.78	-0.56
31500.00	183.23	-0.29	-0.40	0.78	-0.56
32000.00	182.88	-0.28	-0.39	0.78	-0.56
32500.00	182.55	-0.28	-0.39	0.77	-0.55

[Ascent stage with propellant on bottom of tanks]

5000.00	267.62	0.13	5.94	^.	C.
5500.00	262.72	0.11	5.40	^.	C.
6000.00	258.15	0.10	4.95	^.	C.
6500.00	254.53	0.09	4.57	^.	C.
7000.00	251.79	0.08	4.24	^.	C.
7500.00	249.65	0.07	3.96	^.	S.
8000.00	247.99	0.07	3.71	^.	C.
8500.00	246.71	0.06	3.49	^.	C.
9000.00	245.74	0.05	3.30	^.	C.
9500.00	245.04	0.05	3.13	^.	C.
10000.00	244.57	0.05	2.97	^.	C.

[Ascent stage with propellant on top of tanks]

5000.00	260.51	0.20	1.92	^.	C.
5500.00	259.37	0.18	1.65	^.	C.
6000.00	258.18	0.16	1.51	^.	C.
6500.00	256.79	0.15	1.40	^.	C.
7000.00	255.33	0.13	1.30	^.	C.
7500.00	253.85	0.12	1.21	^.	C.
8000.00	252.35	0.11	1.14	^.	C.
8500.00	250.85	0.10	1.07	^.	C.
9000.00	249.34	0.09	1.01	^.	C.
9500.00	247.82	0.09	0.96	^.	C.
10000.00	246.27	0.08	0.91	^.	C.

^aThese values are based on reference 2.^bThese angles are measured from longitudinal axis and do not include electronic null bias.

TABLE I.- MISSION-DEPENDENT CONSTANTS - Continued

(d) Aerodynamics^a

[$X_{cg} = 1040.90$; $Y_{cg} = -0.20$; $Z_{cg} = 5.80$; Weight = 12 121.50 lb;
 $\Delta X = -100.35$ inches; Bank angle bias = -1.97°]

MACH NO.	ALPHA	CL	CD	CL/CD
0.20	170.95	0.23170	0.82584	0.28057
0.40	167.63	0.23412	0.85478	0.27320
0.60	165.71	0.25619	0.93212	0.25901
0.80	163.33	0.31180	1.07015	0.29136
1.00	165.72	0.43050	1.17974	0.40729
1.20	165.37	0.46690	1.14503	0.40074
1.40	164.73	0.54953	1.29744	0.42534
1.60	163.92	0.54084	1.27440	0.42439
1.80	163.98	0.52572	1.23513	0.40376
2.00	164.42	0.49986	1.26612	0.39794
2.20	164.87	0.47174	1.23227	0.38232
2.40	166.77	0.43414	1.22682	0.35387
2.60	167.40	0.42155	1.23593	0.34079
2.80	169.70	0.37900	1.30135	0.29124

^aThese values are based on reference 2.

TABLE I.- MISSION-DEPENDENT CONSTANTS - Concluded

(e) Cross-section area

CSM, ft ²	129.4
CM, ft ²	129.4
LM, ft ²	200.6
APS, ft ²	200.6

(f) Mass properties, spacecraft weight - See reference 3

TABLE II.- CSM RESET VECTORS

(a) Evasive maneuver

(MEAN BESSILIAN)
EARTH REFERENCED

GET = 4 HR 16 MIN 47,56 SEC
X = 18403573,75 FT
Y = 93966810,00 FT
Z = 58881136,50 FT
XDOT = -4537,85 FT/SEC
YDOT = 12713,88 FT/SEC
ZDOT = 7320,02 FT/SEC
X = 1,8794707209 ER
Y = 4,4904896617 ER
Z = 2,8138141036 ER
XDOT = -1,7806772068 ER/HR
YDOT = 2,1872568429 ER/HR
ZDOT = 1,2593141049 ER/HR
WT = 94575,60 LB

TABLE II.- CSM RESET VECTORS - Continued

(b) MCC-1 maneuver

(MEAN BESSILIAN)
EARTH REFERENCED

GET = 9 HR 20 MIN 46.38 SEC

X = -67482915.00 FT

Y = 256582328.00 FT

Z = 149940978.00 FT

XDOT = -4338.75 FT/SEC

YDOT = 6704.25 FT/SEC

ZDOT = 3680.61 FT/SEC

X = -3,2248762548 ER

Y = 12,26156651.7 ER

Z = 7,1653854847 ER

XDOT = -1,7464253753 ER/HR

YDOT = 1,1533786654 ER/HR

ZDOT = ,6332005560 ER/HR

WT = 94275.60 LB

TABLE II.- CSM RESET VECTORS - Continued

(c) LOI-1 maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET = 74 HR 46 MIN 100 SEC
X = -15309472.12 FT
Y = -13694786.75 FT
Z = -8513336.87 FT
XDOT = 1677.85 FT/SEC
YDOT = 4439.36 FT/SEC
ZDOT = 2379.54 FT/SEC
X = -17316096649 ER
Y = -16544470191 ER
Z = -14068356864 ER
XDOT = 12886519656 ER/HR
YDOT = 17637346163 ER/HR
ZDOT = 14093680419 ER/HR
WT = 92428.00 LB

TABLE II.- CSM RESET VECTORS - Continued

(d) LOI-2 maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET = 79 HR 11 MIN .00 SEC
X = 1122574.86 FT
Y = -6121706.00 FT
Z = -2526169.66 FT
XDOT = -4884.16 FT/SEC
YDOT = -683.48 FT/SEC
ZDOT = -373.33 FT/SEC
X = ,0536456527 ER
Y = -,2925443314 ER
Z = -,1207206966 ER
XDOT = -,8402562216 ER/HR
YDOT = -,1175842471 ER/HR
ZDOT = -,0642265659 ER/HR
WT = 68867.15 LB

TABLE II.- CSM RESET VECTORS - Continued

(e) Separation maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET = 97 HR 35 MIN .00 SEC
X = ~~-6052171.62~~ FT
Y = ~~109467.14~~ FT
Z = ~~-64037.54~~ FT
XDOT = 66.93 FT/SEC
YDOT = 4937.23 FT/SEC
ZDOT = 2056.68 FT/SEC
X = ~~-1,2892214209~~ ER
Y = ~~.0052312201~~ ER
Z = ~~-.0030602286~~ ER
XDOT = ~~.0115147795~~ ER/HR
YDOT = ~~.8493856415~~ ER/HR
ZDOT = ~~.3538256884~~ ER/HR
WT = ~~67885.96~~ LB

TABLE II.- CSM RESET VECTORS - Continued

(f) DOI maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET	=	99 HR 14 MIN ,00 SEC
X	=	-3160406.16 FT
Y	=	-4742651.00 FT
Z	=	-2031807.47 FT
XDOT	=	-4562.92 FT/SEC
YDOT	=	2609.11 FT/SEC
ZDOT	=	1003.69 FT/SEC
X	=	-1510296166 ER
Y	=	-2266419958 ER
Z	=	-0970960967 ER
XDOT	=	-7849913910 ER/HR
YDOT	=	,4488640055 ER/HR
ZDOT	=	,1726716720 ER/HR
WT	=	36474.12 LB

TABLE II.- CSM RESET VECTORS - Continued

(g) Phasing maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET = 100 HR 26 MIN .00 SEC
X = 5692865.50 FT
Y = 1866233.95 FT
Z = 880054.66 FT
XDOT = 1817.43 FT/SEC
YDOT = -4654.04 FT/SEC
ZDOT = -1904.93 FT/SEC
X = ,2720508836 ER
Y = ,0891836630 ER
Z = ,0420560874 ER
XDOT = ,3126658387 ER/HR
YDOT = -,8006676137 ER/HR
ZDOT = -,3277175874 ER/HR
WT = 36474.12 LB

TABLE II.- CSM RESET VECTORS - Continued

(h) Insertion maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET = 102 HR 23 MIN .00 SEC
 X = 5508380.37 FT
 Y = 2285113.84 FT
 Z = 1051145.53 FT
 XDOT = 2216.93 FT/SEC
 YDOT = -4505.88 FT/SEC
 ZDOT = -1836.19 FT/SEC
 X = ,2632347010 ER
 Y = ,1092011128 ER
 Z = ,0502321846 ER
 XDOT = ,3813938536 ER/HR
 YDOT = -,7751784548 ER/HR
 ZDOT = -,3158928268 ER/HR
 WT = 36474.12 LB

TABLE II.- CSM RESET VECTORS - Continued

(i) CSI maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET = 103 HR 14 MIN .00 SEC
X = -3926831.00 FT
Y = -4224122.69 FT
Z = -1830011.25 FT
XDOT = -4071.13 FT/SEC
YDOT = 3231.20 FT/SEC
ZDOT = 1271.93 FT/SEC
X = -.1876555569 ER
Y = -.2018625457 ER
Z = -.0874526510 ER
XDOT = -.7003839687 ER/HR
YDOT = .5558852777 ER/HR
ZDOT = .2188193612 ER/HR
WT = 36474.12 LB

TABLE II.- CSM RESET VECTORS - Continued

(j) CDH maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET	=	104 HR 12 MIN .00 SEC
X	=	3608290.09 FT
Y	=	4467148.94 FT
Z	=	1925514.17 FT
XDOT	=	4291.74 FT/SEC
YDOT	=	-2969.07 FT/SEC
ZDOT	=	-1158.86 FT/SEC
X	=	,1724331118 ER
Y	=	,2134762928 ER
Z	=	,0920165479 ER
XDOT	=	,7383384481 ER/HR
YDOT	=	-,5107899234 ER/HR
ZDOT	=	-,1993675288 ER/HR
WT	=	36474.12 LB

TABLE II.- CSM RESET VECTORS - Continued

(k) TPI maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET = 104 HR 49 MIN 36.00 SEC
X = 2954318.16 FT
Y = -4893702.44 FT
Z = -1984615.77 FT
XDOT = -4670.21 FT/SEC
YDOT = -2380.74 FT/SEC
ZDOT = -1075.88 FT/SEC
X = ,1411810741 ER
Y = -,2338604480 ER
Z = -,0948408972 ER
XDOT = -,8034492284 ER/HR
YDOT = -.4095758647 ER/HR
ZDOT = -,1850913800 ER/HR
WT = 36474.12 LB

TABLE II.- CSM RESET VECTORS - Continued

(1) TEI maneuver

(MEAN BESSILLIAN)
LUNAR REFERENCED

GET = 136 HR 20 MIN 00 SEC

X = 4458963.75 FT

Y = -3807283.09 FT

Z = -1508257.50 FT

XDOT = -3618.79 FT/SEC

YDOT = -3611.56 FT/SEC

ZDOT = -1571.00 FT/SEC

X = 2130851392 ER

Y = -1819425970 ER

Z = -10720766699 ER

XDOT = -6225055451 ER/HR

YDOT = -6213224381 ER/HR

ZDOT = -2702703401 ER/HR

WT = 36665.79 Lb

TABLE II.- CSM RESET VECTORS - Concluded

(m) Entry

(MEAN BESSILIAN)
EARTH REFERENCED

GET = 191 HR 31 MIN .00 SEC
X = -22381895.75 FT
Y = -27107130.25 FT
Z = -13999170.87 FT
XDOT = 27103.43 FT/SEC
YDOT = 2360.07 FT/SEC
ZDOT = 1074.46 FT/SEC
X = -1.0695869327 ER
Y = -1.2953966260 ER
Z = -.6689929366 ER
XDOT = 4.6627917886 ER/HR
YDOT = .4060195200 ER/HR
ZDOT = .1848475356 ER/HR
WT = 24581.0 LR

TABLE III.- LM RESET VECTORS

(a) DOI maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET	=	99 HR 14 MIN .00 SEC
X	=	-3134653.62 FT
Y	=	-4748653.12 FT
Z	=	-2034202.37 FT
XDOT	=	-4564.25 FT/SEC
YDOT	=	2603.20 FT/SEC
ZDOT	=	1001.20 FT/SEC
X	=	-1507547144 ER
Y	=	-2269288264 ER
Z	=	-10972105442 ER
XDOT	=	-7852188349 ER/HR
YDOT	=	,4478467666 ER/HR
ZDOT	=	,1722440217 ER/HR
WT	=	36484.00 LB

TABLE III.- LM RESET VECTORS - Continued

(b) Phasing maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET = 100 HR 26 MIN .00 SEC
X = 5564995.87 FT
Y = 1294554.19 FT
Z = 639728.96 FT
XDOT = 1350.77 FT/SEC
YDOT = -4984.91 FT/SEC
ZDOT = -2051.16 FT/SEC
X = ,2659402452 ER
Y = ,0610642070 ER
Z = ,0305713932 ER
XDOT = ,2323820926 ER/HR
YDOT = -,8575888053 ER/HR
ZDOT = -,3528748788 ER/HR
WT = 31069.90 LB

TABLE III.- LM RESET VECTORS - Continued

(c) Insertion maneuver

**(MEAN BESSILIAN)
LUNAR REFERENCED**

GET =	102 HR 23 MIN ,00 SEC
X =	4325721.31 FT
Y =	3940551.06 FT
Z =	1719106.14 FT
XDOT =	3487.22 FT/SEC
YDOT =	-3848.39 FT/SEC
ZDOT =	-1539.42 FT/SEC
X =	,2067177426 ER
Y =	,1883112118 ER
Z =	,0821527131 ER
XDOT =	,5999312997 ER/HR
YDOT =	-,6620660424 ER/HR
ZDOT =	-,2648365460 ER/HR
WT =	30678.70 LB

TABLE III.- LM RESET VECTORS - Continued

(d) CSI maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET	=	103 HR 14 MIN ,00 SEC
X	=	-3029604.81 FT
Y	=	-4660675.94 FT
Z	=	-1995469.22 FT
Xdot	=	-4672.10 FT/SEC
Ydot	=	2511.59 FT/SEC
Zdot	=	961.37 FT/SEC
X	=	-1447788796 ER
Y	=	-2227245700 ER
Z	=	-0953595629 ER
Xdot	=	-8037744686 ER/HR
Ydot	=	,4320862293 ER/HR
Zdot	=	,1653914154 ER/HR
WT	=	8242.80 LB

TABLE III.- LM RESET VECTORS - Continued

(e) CDH maneuver

(MEAN BESSEILLIAN)
LUNAR REFERENCED

GET	=	104 HR 12 MIN .00 SEC
X	=	3057672.19 FT
Y	=	4705019.00 FT
Z	=	2014531.12 FT
Xdot	=	4626.05 FT/SEC
Ydot	=	-2582.51 FT/SEC
Zdot	=	-991.81 FT/SEC
X	=	.1461201608 ER
Y	=	.2248436362 ER
Z	=	.0962704942 ER
Xdot	=	.17958912306 ER/HR
Ydot	=	-.14442872070 ER/HR
Zdot	=	-.1706281286 ER/HR
WT	=	8196.90 LB

TABLE III.- LM RESET VECTORS - Concluded

(f) TPI maneuver

(MEAN BESSILIAN)
LUNAR REFERENCED

GET = 104 HR 49 MIN 36.00 SEC
X = 3182044.47 FT
Y = -4671600.50 FT
Z = -1887936.83 FT
XDOT = -4559.49 FT/SEC
YDOT = -2627.51 FT/SEC
ZDOT = -1176.58 FT/SEC
X = ,1520636678 ER
Y = -,2232466321 ER
Z = -,0902208006 ER
XDOT = -,7844002768 ER/HR
YDOT = -,4520296119 ER/HR
ZDOT = -,2024147492 ER/HR
WT = 8193.70 LB

TABLE IV.- CSM REFSMMAT

(a) Launch through MCC-3 maneuver
 [Earth orbit insertion]

FCT	DSKY	DECIMAL
XIXE	63113	- ,80333900
XIXE	41400	
XIYE	10366	,53013970
XIYE	34742	
XIZE	04256	,27128990
XIZE	15012	
YIXE	01173	,07758620
YIXE	22604	
YIYE	10557	,54483760
YIYE	11721	
YIZE	62510	- ,83494450
YIZE	44235	
ZIXE	66433	- ,59044620
ZIXE	42044	
ZIYE	65465	- ,64969520
ZIYE	66231	
ZIZE	70255	- ,47882090
ZIZE	57761	

TABLE IV.- CSM REFSMMAT - Continued

(b) MCC-4 maneuver through MCC-6 maneuver
 [Lunar landing site]

FCT	DSKY	DECIMAL
XIXE	17152	,95054740
XIXE	34231	
XIYE	73244	-,29246010
XIYE	45255	
XIZE	76247	-,10453090
XIZE	65663	
YIXE	77566	-,01675490
YIXE	67632	
YIYE	71663	-,38436480
YIYE	51045	
YIZE	16611	,92302920
YIZE	16442	
ZIXE	73023	-,31012720
ZIXE	56007	
ZIYE	61772	-,87563160
ZIYE	72333	
ZIZE	72046	-,37025720
ZIZE	73227	

TABLE IV.- CSM REFSMMAT - Concluded

(c) MCC-7 maneuver through entry

FCT	DSKY	DECIMAL
XIXE	15153	.82559312
XIXE	10221	
XIYE	10021	.50208553
XIYE	02553	
XIZE	04075	.25749975
XIZE	16010	
YIXE	77733	-.00450192
YIXE	43662	
YIYE	07312	.40219120
YIYE	10516	
YIZE	61637	-.88676888
YIZE	62667	
ZIXE	66761	-.50424794
ZIXE	65622	
ZIYE	13543	.73095103
ZIYE	36333	
ZIZE	06110	.38384222
ZIZE	15740	

TABLE V.- CSM NAVIGATION UPDATES

(a) Evasive maneuver

X	00253	1.8403574*07
X	05741	
Y	01552	9.3966810*07
Y	01636	
Z	01043	5.8881136*07
Z	26255	
X-DCT	74425	-4.5378463*03
X-DCT	62610	
Y-DCT	11540	1.2713879*04
Y-DCT	07626	
Z-DCT	05447	7.3200214*03
Z-DCT	33462	
T	00136	4 16 47.56
T	01224	

TABLE V.- CSM NAVIGATION UPDATES - Continued

(b) MCC-1 maneuver

X	76614	76,7482915+07
X	51223	
Y	04522	2,5658233+08
Y	25254	
Z	02562	1,4994098+08
Z	26675	
X=DCT	74543	4,3387505+03
X=DCT	50314	
Y=DCT	05067	6,7042499+03
Y=DCT	23736	
Z=DCT	02633	3,6806080+03
Z=DCT	36746	
T	00317	9 26 46,38
T	21676	

TABLE V.- CSM NAVIGATION UPDATES - Continued

(c) LOI-1 maneuver

X	77310	-8,3641035*06
X	71371	
Y	00007	2,0739391*05
Y	26731	
Z	77737	-8,6592552*05
Z	71003	
X-DCT	14305	4,0638651*03
X-DCT	37034	
Y-DCT	20054	5,2776469*03
Y-DCT	05322	
Z-DCT	11264	3,0683802*03
Z-DCT	16061	
T	03174	75 33 43.17
T	11415	

TABLE V.- CSM NAVIGATION UPDATES - Continued

(d) LOI-2 maneuver

X	77476	-5.1958790*06
X	65517	
Y	00160	3.0127422*06
Y	03030	
Z	00053	1.1586670*06
Z	03440	
X-DCT	11121	3.0052858*03
X-DCT	37206	
Y-DCT	14533	4.1595726*03
Y-DCT	12421	
Z-DCT	05341	1.7851842*03
Z-DCT	35232	
T	03335	79 58 45,52
T	13350	

TABLE V.- CSM NAVIGATION UPDATES - Continued

(e) Separation from LM

X	00278	5,0934732+06
X	20325	
Y	00157	2,9874074+06
Y	04704	
Z	00061	1,3359819+06
Z	26517	
X-DCT	10634	2,8892391+03
X-DCT	34044	
Y-DCT	63217	-4,1730077+03
Y-DCT	66423	
Z-DCT	72672	-1,6850430+03
Z-DCT	53457	
T	04161	98 23 15,62
T	32652	

TABLE V.— CSM NAVIGATION UPDATES - Concluded

(f) TEI maneuver

X	77442	75,9666077+06
X	40003	
Y	00044	9,6763257+05
Y	00055	
Z	00012	2,9700952+05
Z	01501	
X-DCT	02552	8,8854185+02
X-DCT	24306	
Y-DCT	16646	4,8640506+03
Y-DCT	27037	
Z-DCT	06166	2,0446628+03
Z-DCT	33202	
T	05705	137 8 22,40
T	12200	

TABLE VI.- LM NAVIGATION UPDATES

(a) DOI maneuver

X	77506	-4.9972561+06
X	42110	
Y	77613	-3.1204168+06
Y	74601	
Z	77714	-1.3896442+06
Z	51350	
X-DOT	66633	-3.0173978+03
X-DOT	43705	
Y-DOT	14370	4.0963831+03
Y-DOT	26747	
Z-DOT	05020	1.6609127+03
Z-DOT	13774	
T	04207	99 21 58.80
T	12750	

TABLE VI.- LM NAVIGATION UPDATES - Continued

(b) Phasing

X	00320	5.5904285+06
X	<u>00865</u>	
Y	77721	-1.2536341+06
Y	53310	
Z	77760	-4.2082524+05
Z	<u>52750</u>	
X-DOT	74135	-1.2523074+03
X-DOT	65565	
Y-DOT	60615	-4.9945052+03
Y-DOT	<u>66173</u>	
Z-DOT	71457	-2.1022879+03
Z-DOT	47023	
T	04241	100 34 20.89
T	<u>33012</u>	

TABLE VI.- LM NAVIGATION UPDATES - Continued

(c) Insertion

X	00317	5.5876326+06
X	34615	
Y	00077	1.7080111+06
Y	21454	
Z	00036	8.1228364+05
Z	07100	
X-DOT	04355	1.4646465+03
X-DOT	26114	
Y-DOT	50623	-4.9909998+03
Y-DOT	45225	
Z-DOT	71575	-2.0518125+03
Z-DOT	77547	
T	04314	102 31 17.80
T	25404	

TABLE VI.- LM NAVIGATION UPDATES - Continued

(d) CSI maneuver

X	77512	-4.8712492+06
X	<u>70125</u>	
Y	77614	-3.1090074+06
Y	<u>52254</u>	
Z	77714	-1.3826389+06
Z	<u>61626</u>	
X-DOT	-66377	-3.172173+03
X-DOT	<u>53034</u>	
Y-DOT	14244	4.0426842+03
Y-DOT	<u>35237</u>	
Z-DOT	04753	1.6270494+03
Z-DOT	<u>04226</u>	
T	04337	103 21 46.00
T	<u>04750</u>	

TABLE VI.- LM NAVIGATION UPDATES - Continued

(e) CDH maneuver

X	00265	4 • 8717576+06
X	10337	
Y	00164	3 • 1402653+06
Y	32702	
Z	00063	1 • 3957127+06
Z	35612	
X-00T	11356	3 • 1057709+03
X-00T	31251	
Y-00T	63426	-4 • 0866718+03
Y-00T	56007	
Z-00T	72767	-1 • 6456741+03
Z-00T	71473	
T	04364	104 19 42 • 40
T	13740	

TABLE VI.- LM NAVIGATION UPDATES - Concluded

(f) TPI maneuver

X	00043	9.6158129+05
X	30704	
Y	77465	-5.4347532+06
Y	71175	
Z	77654	-2.2458622+06
Z	56011	
X-DOT	57617	-5.3214652+03
X-DOT	56275	
Y-DOT	75520	-7.6840547+02
Y-DOT	73031	
Z-DOT	76566	-4.1614191+02
Z-DOT	62414	
T	04402	104 56 59.40
T	00664	

TABLE VII.- DETAILED MANEUVER TABLES

(a) Evasive maneuver

C STA IN		L STA ID		STA IN		WT		94575.60	
GETV CODE	O C ,0	GETV REF	O 0 EARTH	GETV CTR	O 0 W	WT WF	WT WF	WT WF	WT WF
GETI	4 28 47,6	DT B	0 2.2	DT T ₀	0 .59	REFS	MAT	DEL P	.91
GETI	21 17 47,6	DT L	,00	DT T ₀	4.13	01 REF	DEL Y	DEL Y	.23
DVM	19.7	VGX	-4,9	OR	180,7	YR	.0	YH	3.0
EVRFN	1.0	VGY	-,6	IP	254,4	PB	.0	PH	283,8
DVC	15.5	VGZ	19,1	MY	359,1	RR	.0	RH	177.1
VF	5,09	H BI	16656,0	HA	300340,887	VP	.00		
VS	-,00	P BI	31 36,N	HP	119,410	THETA P	.00		
VD	19,01	L BI	414 9 W	L AN	0 0 E	DELTA P	.00		
DH	20103,45	F BI	131,69	E	.97681696	P LLS	0 0 N		
PHASE	DCT	,000		I	31,6128	L LLS	0 0 E		
PHASE	DCT	,000	0 0	WP	318,5305	R LLS	,000		
WEDGE ANG	,000		UNTIL						
YD	,000								
TARGETS									
PGNS	AGS								
EXT CV	CSM	EXF DV							
GETI	4 28 47,6	GETI	0 0 ,0	GETI	0 0 ,0	LAMBERT		MVR	
VX	5,0949	VX	,0000 F	TP	0 0 ,0			GETI	0 0 ,0
VY	7,0000	VY	,0000 X					APSYS	0 0 ,0
VZ	19,0144	VZ	,0000 Y					ELEV	,000
								TP I	0 0 ,0
								DT	0 0 ,0
								OPTION	,000

TABLE VII.- DETAILED MANEUVER TABLES - Continued

(b) MCC-1 maneuver

C STA ID	L STA ID	STA ID	WT	WT							
GETV CODE	0 0 .0	GETV REF	0 0 EARTH	GETV REF	0 0 EARTH						
GETI	9 38 46,4	DT E	0 7.5	DT T0	.59	REF SMMAT	DEL P	.91			
PETI	26 27 46,4	DT L	.00	DT T0	4.14	01 REF	DEL Y	.23			
DVM	57,0	VGX	7,6	OR	7,3	YB	YH	167,2			
CVREN	0	VGY	11,8	IP	92,0	PB	PH	37,9			
DVC	53.9	VGZ	-55,7	MY	11,4	RB	RH	180,6			
VF	*42,90	H BI	47705,4	HA	308867,715	VP		.00			
VS	10,47	P BI	29 24 N	HP	*5,101	THETA P		.00			
VD	*35,99	L BI	168 24 W	AN	0 0 E	DELTA P		.00			
DH	*51157,91	F BI	151,98	E	.97822648	P LLS	O N				
PHASE		DCT	.000	I	31,7000	L LLS	O E				
PHASE		DCT	.000	W	318,4688	R LLS	O E				
WEDGE ANG		UNTIL	.000								
YD			.0000								
TARGETS											
PGNS	AGS	CSM	EXT DV	EXT DV	GETI	LAMBERT	MVR				
EXT DV					0 0 .0	0 0 .0	GETI	0 0 .0			
GETI	9 38 46,4	VX		.0000	T F	0 0 .0	APSIS	0 0 .0			
VX	-42,9022	VY		.0000	X	.00 ELEV	ELEV	0 0 .0			
VY	-10,4653	VZ		.0000	Z	.00 DT	DT	0 0 .0			
VZ	-38,9920					.000 OPTION	OPTION	0 0 .0			

TABLE VII.- DETAILED MANEUVER TABLES - Continued

(c) LOI-1 maneuver

C STA ID	L STA ID	STA IN	WT
GETV CODE	0 C .0 REF	GETV 0 LUNAR GETR	WC WL WF
GET1	75 45 43.2	DT B 6 1.0	.59
GET1	92 34 43.2	DT L ,00	5.66
DVM	2978.4	VGX *1927.7	355.6
DVRFY	" 0	VGY -894.0	228.5
DVC	2972.2	VGZ 286.9	341.7
VF	-2748.01	H BI 77.7	171.296
VS	-587.45	P BI 1 41.5	52.090
VD	-986.87	F BI 165 33 W	179.36 W
CH	-993.83	F BI 243.18	.05684461
PHASE	000	I	178.7021
PHASE	DOT	WP	-7,1044
WEDGE	ANG	0 0 UNTIL	L LLS
YD	,0000		R LLS
TARGETS			
PGNS	AGS	LAMBERT	MVR
EXT DV	EXT DV	0 0	0 0 .0
GET1	CSM 75 45 43.2	GET1 0 0	GET1 0 0 .0
VX	*2912.919 R	VX ,0000 T F	APSIS 0 0 .0
VY	*587.4500	VY ,0000 X	ELEV .00 .00
VZ	-200.9700	VZ ,0000 Y	TPI 0 0 .0
		Z ,000 DT	DT 0 0 .0
		C ,000 OPTION	

TABLE VII.— DETAILED MANEUVER TABLES - Continued

(d) LOI-2 maneuver

C STA ID	L STA ID	STA ID	WT		
GETV CODE	GETV REF	GETV 0 0 LUNAR	GETV 0 0 GETR	GETV 0 0 REFMMAT	DEL P DEL Y
GET1	HO 10 45.5	DT E	0 13.6	DT TO	.59 1.44
PET1	96 59 45.5	DT L	20.00	FV TO	5.82 DEL Y -.66
DVM	138.5	VGX	-108.0	OR	YH .0
DUREM	132.3	VGY	0	IP	PH .0
DVC	VGZ	H6.7	359.7	RB	RH 100.0
VF	-138.50	H BI	57.9	HA	58.619 VP .00
VS	.00	P BI	C 17 N	HP	57.900 THETA P .00
VD	-.91	L BI	164 2 E	L AN	176 41 E DELTA P .04
PK	-996.40	F BI	359.68	E	.00036066 PLLS 0 0 N
PHASE	0.00			I	178.7598 L PLLS 99.0 E
PHASE	DT	O U	WP	J	97.9068 R PLLS .000
KEDGE	ANG	UNTIL			
VP	.0000				
TARGETS					
FIGNS	AGS				
EXT PV	CSN	EXT LV			
GET1	HO 10 45.5	GET1	0 0 .0	GET1	LAMBERT .0
VX	-138.5000	VX	.00000	T F	0 0 .0
VY	.0000	VY	.00000	X	.00000
VZ	.0000	VZ	.00000	Y	.00000
				Z	.00000
				C	.00000
MVR	0 0 .0				
GET1	0 0 .0				
APSIS	0 0 .0				
ELEV	0 0 .0				
TRI	0 0 .0				
NT	0 0 .0				
OPTION	.000				

TABLE VII.- DETAILED MANEUVER TABLES - Continued

(e) Separation from LM

C SIA 1L		C SIA 1U		SIA 1L		SIA 1U		W	
GETV COUNT	L U •U	GETV REF	L U •U	GETV REF	L U •U	GETV REF	L U •U	W L W C W F	36484.00
GETI	96 35 15.0	U 1 6	U 1 6	U 1 6	U 1 6	U 1 6	U 1 6	W L W C W F	0.00
PTT 1	115 24 15.0	U 1 U	U 1 U	U 1 U	U 1 U	U 1 U	U 1 U	W L W C W F	0.00
VVM	2.0 5	V G A	-2.0 4	V G A	-2.0 4	V G A	-2.0 4	W L W C W F	180.0
DVRTR	•U	V G Y	•U	V G Y	•U	V G Y	•U	W L W C W F	270.0
DVG	2.0 5	V G Z	•6	V G Z	•6	V G Z	•6	W L W C W F	180.0
VF	-•U 1	H B I	57.0 9	H A	60.0 377	V P	•UU		
VS	•UU	F B I	U 57 N	NP	59.0 177	THEIA P	•UU		
VU	2.0 5 U	L B I	39 8 E	L A N	177 45 E	DELLA P	359.0 4		
DH	-996.0 35	F B I	344.0 11	E	•UUUOUZI 9	P LLS	0 U N		
PHASE	•UUU	D U T	•UU	D U T	1 178.0 7624	L LLS	U U E		
PHASE ANG	•UUU	W E L G E	•UUU	W E L G E	W P 194.0 1333	K LLS	938.0 493		
YD	•UUU	ANG	•UUU	ANG	UNTIL	C			
TARGETS									
PGNS	AGS		AGS		AGS		MVR		
EXT DV	CSM		EXT DV		EXT DV		EXT DV		
GETI	98 35 15.0	6	GETI	U 0	GETI	U 0	GETI	U 0	
VX	•UUU	V X	•UUU	•UUU	T F	U	•UU	•UU	
VY	•UUU	V Y	•UUU	•UUU	X	•UU	APIS	U	
VZ	2.0 5 UU	V Z	•UUU	•UUU	Y	•UU	ELLY	•UU	
					Z	•UU	TPI	0	
					C	•UUU	OPTION	U	
W I AFTER	67866.0 93	PIRIM	•UU	YIRIM	•UU			•UU	

TABLE VII.- DETAILED MANEUVER TABLES - Continued

(f) DOI maneuver

C STA ID	L STA ID	STA ID	WT
GETV CODE	0 0 .0 REF	0 0 .0 LUNAR GETR	31302.00 WL WF .00
GETI	99 33 58.8	DT 8	0 26.9
PETI	116 22 58.8	DT U	0 .00
DVM	71.1	VGX	19.1
DREM	.0	VGY	.0
DVC	69.6	VGZ	68.5
YF	-71.010	H BI	57.8
VS	.00	P BI	0 58 5
VO	-.49	L BI	139 45 W
DH	.00	F BI	159.07
PHASE	.000.000		I
PHASE	DOT 0.00	O O	178.7623
WEDGE	ANG 0.00	UNTIL	L LLS
YD	.00000		R LLS
TARGETS			
PGNS	AGS		MVR
EXT DV	LM	EXT DV	
GETI	99 33 58.8	GETI	GETI 0 0 .0
VX	-71.1000	VX	-71.0935 T F 0 0 .0
VY	.0000	VY	-.0000 X .00 APSIS .00
VZ	-.2700	VZ	-.9963 Y .00 ELEV .00
			Z .00 TPI 0 0 .0
			C .000 UT 0 0 .0
			OPTION

TABLE VII.— DETAILED MANEUVER TABLES — Continued

(g) Phasing

C STA 10				L STA 10				STA 10				W1			
GETV CODE	U	U	•U	GETV REF	U	U	LUNAK	GETV GETK	U	U	U	U	U	W2	
GET1	100	46	20.9	L1 B	U	41.7	D1	TO	•38	KEFMMAT	DEL P	5.47			
GET1	117	35	20.9	D1 U	B.00	D1	DV	TO	2.43	LANDIN	DEL Y	5.39			
DVM	195.4			VGX	-2U.8	Y	360.0	YB	•U		YH		•7		
DREM	•D			VGY	•U	IP	264.4	PB	264.4		PH		29.3		
DVC	193.0			VGZ	194.3	MR	.6	RB	.6		RH		•3		
VF	171.28			H BI	15.3	HA	190.942	VP					-•61		
VS	-•.00			P BI	0	N	HP	7.549	THETA P				•00		
VD	-94.02			L BI	11 14	W	L AN	176.52	E	DELTA P			359.04		
DH	0.00			F BI	48.46	E	•U8836181	P LLS			U	U	N		
PHASE	000.000					I	178.7621	L LLS			O	U	E		
PHASE	DUT	0.00			0	D	WP	-206.3455	R LLS						
WEDGE	ANG	•000			UNTIL										
YD					•0000										
TARGETS															
PGNS				AGS				LAMBERT				MVR			
EXT DV	LM	EXT DV		GET1	100	46	20.9	GET1	U	U	U	GET1	0	U	•0
GET1	100	46	20.9	VX	170.4000	VX	171.9869	1 F	U	U	U	APSIS	0	U	
VY				VY	-•00000		-•00000	X	•UU			ELBV		•UU	
VZ				VZ	-•95.6000		-•92.7148	Y	•UU			TP1	0	U	U
							Z	Z	•UU			DT		U	U
							C	C	•UUU			OPTION			

TABLE VII.- DETAILED MANEUVER TABLES - Continued

(h) Insertion maneuver

C STA ID	L STA ID	STA 1D	WT	8420.80
GETV CODE	GETV REF	GETV LUNAR	WC	WL
GETV CODE	GETV REF	GETV GETR	WF	WF
GETI	102 43 17.9	DT B	0 15.0	DT TO .10
PETI	119 32 17.8	DT U	4.00	DT TO 1.17
DVM	207.0	VGX	96.8	YB .0
DVREM	0	V6Y	.1	REFSMAT
DVC	205.8	V6Z	-182.9	LANDIN
		MR	.0	YH
			RB	PH 242.1
			180.0	RH 24.4
				360.0
VF	-188.55	H 31	8.0	VP .00
VS	.10	P 31	0 39 N	THETA P .00
VD	-85.36	L 31	19 0 E	DELTA P 359.04
DH	0.00	E 31	353.72	P LLS 0 0 N
PHASE	000,000		E .01924742	LLS 0 0 E
PHASE DOT	0.00		I 178.7634	R LLS 938.493
WEDGE ANG		0 0	W P 128.1438	
YD		UNTIL		
				TARGETS
PGNS				
EXT CV	LW	EXT CV		
GETI	102 43 17.3	SETI	102 43 17.8	LAMBERT
VX	-189.2000	VX	-188.2066	MVR
VY	.1000	VY	.1000	GETI 0 0 .0
VZ	-83.9000	VZ	-96.1053	APSIS 0 0 .0
			Z	ELEV .00
			C	TPI .00
				DT .00
				OPTION .00

TABLE VII.— DETAILED MANEUVER TABLES — Continued

(i) CSI maneuver

SYN ID	L STN 10	L STN 10	REFSMMA	DEL P	•00
GE TV	0 0 •0	GE TV	0 0 •0	LANDIN	DEL Y
DE	REF	REF	GE TV	0 0 •0	YH
GETI	104 33 46•0	DT U	0 32•3	DT TO	•00
GETI	123 22 46•0	DT U	•00	DV TO	•00
DM	50.5	VUX	-14•8	0Y	•0
DVRM	•0	VUX	-48•0	105•8	YB
DVC	50.5	VUX	-48•6	MR	105•8
				360.0	PB
				360.0	RH
				360.0	360.0
VE	50.50	H E I	43•2	HH	45•166
VE	•00	F b i	0 58 5	HP	44•739
VE	•13	L b i	141 55 N	L AN	177 10 E
VE	0.00	F b i	180.06	E	000021744
PHASE	000.000		I	178.7636	P LTS
PHASE	001	0.00	0	L LTS	0 0 N
STAGE ATG	•000	0	NP	R LTS	0 0 E
STAGE ATG	•000	0	UNT		
STAGE ATG	•000	0			
TARGETS					
PA NS	A6S				
EXT DV	Lm	EXT DV			
GETI	103	33 46•0	GETI	0 0 •0	GETI
VX	50.5000	VX	50.5034	T F	0 0 APSIS
YY	•0000	YY	•0000	X	•00 ELEV
VZ	•6000	VZ	•4369	Y	•00 TPI
				Z	•00 DT
				C	•000 OPTION

TABLE VII.- DETAILED MANEUVER TABLES - Continued

(j) CDDH maneuver

C STA ID	L STA ID	STA ID	WT
GETV	0 0 .0	GETV REF	8196.90
CODE	DT B DT U	DT T0 DT Y	WT WC
GETI	104 31 42.4	DT B 0 2.2	REF SMMAT
GETI	121 20 42.4	DT U .00	DEL P .00
DVX	3.4 VGX	0Y -.4	LANDIN .0
DVY	-.0 VGY	.P -.0	LANDIN .0
DVZ	3.4 VGZ	.1 MR	YH 180.0
VF	-.80 H BI	42.8 HA	PY -.00
VS	.00 P BI	.HP .58 N	THETA P .00
VO	3.30 L BI	37 30 E	DELTA P 359.04
DH	-.00 F BI	19.98 E	P LLS .0 .0 N
PHASE	000.000	I	178.7635 L LLS 0 0 E
PHASE	DOT 0.00	AP 0 0	188.4133 R LLS 938.493
WEDGE	ANG .000	UNTIL	
YD	.0000		
TARGETS			
PIAS	AGS	LAMBERT	MVR
EXI DV	LH	LAT DV	GETI 0 0 0 0
GETI	104 31 42.4	GETI 104 31 42.4 GETI 0 0 0 0	GETI 0 0 0 0
VX	-.8000	VX -.8032 TF 0 0 0 0	APSIS 0 0 0 0
VY	.0000	VY .0000 X 0 0 0 0	ELEV .000
VZ	3.3000	VZ -.2992 Y -.0000 TPI 0 0 0 0	DT 0 0 0 0
		Z .000 C .000 OPTION	

TABLE VII.- DETAILED MANEUVER TABLES - Continued

(k) TPI maneuver

C STA ID	L STA ID	STA ID	WT
GETV	0 0 .0	GETV REF	WC
CODE		LUNAR	WL
GETI	105 8 59.4	DT B	0 15.8
PETI	121 57 59.4	DT U	.00
DVM	24.8	VGX	-23.8
DVREM	*U	VGY	*1
DVC	24.8	VGZ	7.1
		MR	.2
VF	22.18	H BI	42.2
VS	*1 0	P BI	1 6 5
VD	-11.14	L BI	78 45 W
DH	0.00	F BI	14.57
PHASE	000.000		E
PHASE DOT	0.00		*00922387
WEDGE ANG	*000	O O	I
YD	.0000	UNTIL	*178.7641
			*-130.0033
			R LLS
			938.493
			TARGETS
PGNS		AGS	
EXT DV	LM	EXT DV	
GETI	105 8 59.4	GETI	105 8 59.4
VX	22.1000	VX	22.1802
VY	*1000	VY	*1000
VZ	-11.3000	VZ	-11.1417
			Y
			Z
			C
			MVR
			GETI
			APSIS
			ELEV
			TPI
			DT
			OPTION

TABLE VII.— DETAILED MANEUVER TABLES — Concluded

(1) TEI maneuver

C STA ID	L STA ID	STA ID	WT
GETV CODE	0 0	0 0	WC
GETV REF	0 LUNAR	0 GETR	WL
			WF
GETI	137 20 22,4	DT E 2 48.5	36665.79
PETI	154 9 22,4	DT L 20,00	
DVM	3622,7	VGX 2122,1	
DVREN	0	VGY 34,3	
DVC	3607.0	VGZ 2915,7	
VF	3588,08	H BI 57,8	
VS	-34,75	P BI C 8,6	
YD	497,21	L BI 152,32	
DH	-998,03	E 11,68	
PHASE	,000	E 1,8933174	
PHASE DOT	,000	I 178,9841	
WEDGE ANG	,000	WP ,7381	
YD	,0000	UNTIL	
			TARGETS
PGNS			
EXT DV	CSM	AGS	MVR
GETI	137 20 22,4	EXT DV	GETI
VX	3618,0662	GETI	0 0 0
YY	734,7524	0,0000	APSES
VZ	176,4467	TF	0 0 0
		1,0000	ELIV
		1,0000	TPJ
		1,0000	DT
		Z	0 0 0
		C	OPTION

TABLE VIII.- FDAI ANGLES FOR LM MANEUVERS

Maneuver	Roll	Pitch	Yaw
DOI	0.600	286.100	-0.
Phasing	0.600	264.400	-0.
Insertion	180.000	242.100	360.000
CSI	0.	105.800	-0.
CDH	180.000	2.300	360.000
TPI	0.240	196.689	0.120

TABLE IX.- CSM EXTERNAL ΔV UPDATES

(a) Evasive maneuver

OID	FCT	DSKY V71	DECIMAL
INDEX			
1			
2	ADD		
3	VGX	00001	0.50949000E 01
4	VGX	37467	
5	VGY	00000	0.
6	VGY	00000	
7	VGZ	00007	0.19014399E 02
10	VGZ	15306	
11	TIGN	00142	4 28 47.56
12	TIGN	15724	

TABLE IX.- CSM EXTERNAL ΔV UPDATES - Continued

OID	FCT INDEX	DSKY V71	DECIMAL
1	ADD		
2	VGX	77757	-0•42902246E 02
3	VGX	50303	
4	VGY	00004	0•10465287E 02
5	VGY	02517	
6	VGZ	77761	-0•35992011E 02
7	VGZ	76516	
10	TIGN	00323	9 38 46•38
11	TIGN	36376	
12			

(b) MCC-1 maneuver

TABLE IX.- CSM EXTERNAL ΔV UPDATES - Continued

(c) LOI-1 maneuver

OID	FCT INDEX	DSKY V71	DECIMAL
1			
2	ADD		
3	VGX	75617	-0.29129198E 04
4	VGX	61254	
5	VGY	77432	-0.58744998E 03
6	VGY	71725	
7	VGZ	77661	-0.20097003E 03
10	VGZ	62757	
11	TIGN	03200	75 45 43.17
12	TIGN	26115	

TABLE IX.- CSM EXTERNAL ΔV UPDATES - Continued
 (d) LOI-2 maneuver

OID	FCT	DSKY	V71	DECIMAL
INDEX				
1				
2	ADD			
3	VGX	77711		-0.13849999E 03
4	VGX	76703		
5	VGY	00000	0.	
6	VGY	00000		
7	VGZ	00000	0.	
10	VGZ	00000		
11	TIGN	03341	80 10	45.52
12	TIGN	30050		

TABLE IX.- CSM EXTERNAL ΔV UPDATES - Continued

(e) Separation from LM

OID	FCT	INDEX	DSKY	V71	DECIMAL
1					
2	ADD				
3	VGX		00000		0.
4	VGX		00000		
5	VGY		00000		0.
6	VGY		00000		
7	VGZ		00000		0.25000000E 01
10	VGZ		37154		
11	TIGN		04166	98	35 15•60
12	TIGN		07350		

TABLE IX.- CSM EXTERNAL ΔV UPDATES - Concluded

(f) TEI maneuver

OID	FCT	DSKY V71	DECIMAL
INDEX			
1	ADD		
2	VGX	02603	0.36180662E 04
3	VGX	22107	
4	VGY	77762	-0.34752418E 02
5	VGY	56101	
6	VGZ	00104	0.17644970E 03
7	VGZ	32720	
10	TIGN	05711	137 20 22.41
11	TIGN	26700	
12			

TABLE X.- LM EXTERNAL ΔV UPDATES

(a) DOI maneuver

OID	FCT	DSKY V71	DECIMAL
	INDEX		
1			
2	ADD		
3	VGX	77744	-0.71099997E 02
4	VGX	50257	
5	VGY	00000	0.
6	VGY	00000	
7	VGZ	77777	-0.27000000E 00
10	VGZ	74501	
11	TIGN	04213	99 33 58.80
12	TIGN	27450	

TABLE X.- LM EXTERNAL ΔV UPDATES - Continued

(b) Phasing maneuver

OID	FCI INDEX	DSKY V71	DECIMAL
1			
2	ADD		
3	VGX	00102	0•17040000E 03
4	VGX	17301	
5	VGY	00000	0•
6	VGY	00000	
7	VGZ	77732	-0•95599996E 02
10	VGL	66360	
11	TIGN	04246	100 46 20•89
12	TIGN	07510	

TABLE X.- LM EXTERNAL ΔV UPDATES - Continued

(c) Insertion maneuver

OID	FCT	DSKY V71	DECIMAL
INDEX			
1			
2	ADD		
3	VGX	77666	-0.18919999E 03
4	VGX	45722	
5	VGY	00000	0.99998000E-01
6	VGY	01177	
7	VGZ	77737	-0.83899994E 02
10	VGZ	50424	
11	TIGN	04321	102 43 17.80
12	TIGN	02104	

TABLE X.- LM EXTERNAL ΔV UPDATES - Continued

(d) CSI maneuver		DECIMAL	
OID	FACT	DSKY	V71
INDEX			
1			
2	ADD		
3	VGX	00023	0•50500000E 02
4	VGX	26362	
5	VGY	00000	0•
6	VGY	00000	
7	VGZ	77777	-0•60000000E 00
10	VGZ	70404	
11	TIGN	04343	103 33 46•00
12	TIGN	21450	

TABLE X.- LM EXTERNAL ΔV UPDATES - Continued

OID	FCT INDEX	DSKY V71	DECIMAL
1			
2	ADD	777777	-0•80000000E 00
3	VGX	66005	
4	VGY	00000	0•
5	VGY	00000	
6	VGY	00001	0•33000000E 01
7	VGZ	11146	
10	VGZ	04370	104 31 42•40
11	TIGN		
12	TIGN	30440	

(e) CDH maneuver

TABLE X.- LM EXTERNAL ΔV UPDATES - Concluded

OID	INDEX	FCT	DSKY V71	DECIMAL
1				
2		ADD		
3		VGX	00010	0•22099999E 02
4		VGX	23722	
5		VGY	00000	0•09999999E 00
6		VGY	01177	
7		VGZ	77773	-0•11300000E 02
10		VGZ	62730	
11		TIGN	04406	105 8 59•40
12		TIGN	15364	

TABLE XI.- MANEUVER PADS

(a) Evasive maneuver

P30 MANEUVER									
SET STARS		S	P	S	/	G	&	N	PURPOSE
R ALIGN	—	9	4	5	7	5	6		WT N47
P ALIGN	—	+	0	0	0	9	1		P TRIM N48
Y ALIGN	—	+	0	0	0	2	3		Y TRIM
ULLAGE <u>No ullage</u>		+	0	0	0	0	4		HRS GETI
		+	0	0	0	2	8		MIN N33
		+	0	4	7	5	6		SEC
HORIZON/WINDOW		+	0	0	0	5	1		ΔV_X N81
		+	0	0	0	0	0		ΔV_Y
		+	0	0	1	9	0		ΔV_Z
		X	X	X	1	8	1		R
		X	X	X	2	5	4		P
		X	X	X	3	5	9		Y
		+							H_A N44
		+			1	1	9	4	H_P (DMT)
		+	0	0	1	9	7		ΔVT
		X	X	X	0	0	3		BT
		X	0	0	1	5	5		ΔVC
		X	X	X	X	2	4		SXTS
		+	2	7	3	3	0		SFT
		+	0	8	2	0	0		TRN
		X	X	X					BSS
		X	X						SPA
		X	X	X					SXP
OTHER			0						LAT N61
									LONG
		+							RTGO EMS
		+							V10
					•	•	•		GET 0.05G

TABLE XI.—MANEUVER PADS - Continued

(b) MCC-1

P30 MANEUVER									
SET STARS					PURPOSE				
S	P	S	G	&	N	PROP/GUID			
9	4	5	7	5	.6	WT	N47		
+	0	0	0	9	1	P	TRIM	N48	
+	0	0	0	2	3	Y	TRIM		
+	0	0	0	0	9	HRS	' GETI		
+	0	0	0	3	8	MIN	N33		
+	0	4	6	3	8	SEC			
-	0	0	4	2	9	ΔV_X	N81		
+	0	0	1	0	5	ΔV_Y			
-	0	0	3	6	0	ΔV_Z			
X	X	X	0	0	7	R			
X	X	X	0	9	2	P			
X	X	X	0	1	1	Y			
+						H_A	N44		
-	0	0	0	5	1	H_P	(DMT)		
+	0	0	5	7	0	ΔV_T			
X	X	X	0	0	8	BT			
X	0	0	5	3	9	ΔV_C			
X	X	X	X	1	6	SXTS			
+	0	9	9	5	0	SFT			
+	2	4	6	0	0	TRN			
X	X	X				BSS			
X	X					SPA			
X	X	X				SXP			
OTHER			0			LAT	N61		
						LONG			
						RTGO	EMS		
						V10			
						GET	0.05G		

TABLE XI.- MANEUVER PADS - Continued

(c) LOI-1

P30 MANEUVER										
SET STARS			S	P	S	G	&	N	PURPOSE	
R ALIGN			+ 9	2	4	2	8		WT	N47
P ALIGN			+ 0	0	0	9	6		P _T TRIM	N48
Y ALIGN			- 0	0	0	2	5		Y _T TRIM	
ULLAGE			+ 0	0	0	7	5		HRS	GETI
			+ 0	0	0	4	5		MIN	N33
			+ 0	4	3	1	7		SEC	
HORIZON/WINDOW			- 2	9	1	2	9		ΔV_X	N81
			- 0	5	8	7	4		ΔV_Y	
			- 0	2	0	1	0		ΔV_Z	
			X	X	X	3	5	6	R	
			X	X	X	2	2	8	P	
			X	X	X	3	4	2	Y	
			+ 0	1	7	1	3		H_A	N44
			+ 0	0	5	2	1		H_P	(DMT)
			+ 2	9	7	7	9		ΔVT	
			X	X	X	6	0	2	BT	
			X	2	9	7	2	2	ΔVC	
			X	X	X	X	2	1	SXTS	
			+ 2	6	7	5	0		SFT	
			+ 1	6	0	0	0		TRN	
			X	X	X				BSS	
			X	X					SPA	
			X	X	X				SXP	
OTHER			0						LAT	N61
									LONG	
			+						RTGO	EMS
			+						V10	
									GET	0.05G

TABLE XI.- MANEUVER PADS - Continued

(d) LOI-2

P30 MANEUVER							
SET STARS	S	P	S	G	&	N	PURPOSE
	+	6	8	8	6	7	WT N47
	+	0	0	1	4	4	P TRIM N48
	-	0	0	0	6	6	Y TRIM
	+	0	0	0	8	0	HRS GETI
	+	0	0	0	1	0	MIN N33
	+	0	4	5	5	2	SEC
	-	0	1	3	8	5	ΔV_X N81
	+	0	0	0	0	0	ΔV_Y
	+	0	0	0	0	0	ΔV_Z
ULLAGE 2 quad 20 second	X	X	X	0	0	0	R
	X	X	X	2	1	9	P
	X	X	X	0	0	0	Y
	+	0	0	5	8	6	H_A N44
	+	0	0	5	7	9	H_P (DMT)
	+	0	1	3	8	5	ΔV_T
	X	X	X	0	1	4	BT
	X	0	1	3	2	3	ΔV_C
	X	X	X	X	2	2	SXTS
	+	0	1	9	1	0	SFT
HORIZON/WINDOW	+	0	5	8	0	0	TRN
	X	X	X				BSS
	X	X					SPA
	X	X	X				SXP
		0					LAT N61
							LONG
	+						RTGO EMS
	+						V10
							GET 0.05G

TABLE XI.- MANEUVER PADS - Continued

(e) Separation from LM

TABLE XI.- MANEUVER PADS - Continued

(f) DOI

P30 LM MANEUVER									
				D	O	I			PURPOSE
+	0	0		+	0	0	0	9	9
+	0	0	0	+	0	0	0	3	3
+	0			+	0	5	8	8	0
				-	0	0	7	1	1
				+	0	0	0	0	0
				-	0	0	0	0	3
+				+	0	0	7	1	1
X	X	X		X	X	X	0	2	7
X	X	X		X	X	X	0	0	1
X	X	X		X	X	X	2	8	6
				-	0	0	7	1	1
				+	0	0	0	0	0
				-	0	0	0	1	0
X	X	X		X	X	X	0	2	7
X	X			X	X		+ 0	5	AZ
X	X			X	X	-	2	5	EL

TABLE XI.- MANEUVER PADS - Continued

(g) Phasing

TABLE XI.- MANEUVER PADS - Continued

(h) Insertion

TABLE XI.- MANEUVER PADS - Continued

(i) CSI

TABLE XI.- MANEUVER PADS - Continued

(j) CDH

TABLE XI.- MANEUVER PADS - Continued

(k) TPI

TABLE XI.- MANEUVER PADS - Continued

(1) TEI

P30 MANEUVER									
SET STARS							PURPOSE		
		S	P	S	G	&	N	PROP/GUID	
R ALIGN	-	+	3	6	6	6	6	WT	N47
P ALIGN	-	-	0	0	0	7	2	P TRIM	N48
Y ALIGN	-	+	0	0	0	2	3	Y TRIM	
ULLAGE	2 quads	+	0	0	1	3	7	HRS GETI	
20 second		+	0	0	0	2	0	MIN N33	
		+	0	2	2	4	1	SEC	
		+	0	3	6	1	8.1	ΔV_X	N81
		-	0	0	3	4	8	ΔV_Y	
		+	0	1	7	6	4	ΔV_Z	
		X	X	X	1	8	0	R	
		X	X	X	0	5	1	P	
		X	X	X	0	0	1	Y	
		+		N	A			H_A	N44
		+	0	0	5	9	1	H_P (DMT)	
		+	3	6	2	2	7	ΔVT	
		X	X	X	2	4	9	BT	
		X	3	6	0	4	8	ΔVC	
		X	X	X	X	1	1	SXTS	
		+	0	1	4	9	0	SFT	
		+	2	1	8	0	0	TRN	
		X	X	X				BSS	
		X	X					SPA	
		X	X	X				SXP	
OTHER			0					LAT	N61
								LONG	
		+						RTGO EMS	
		+						V10	
								GET 0.05G	

TABLE XI.- MANEUVER PADS - Concluded

(m) Lunar entry

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1. Apollo Mission F (AS-505/CSM-106/LM-4) Spacecraft Operational Trajectory, Revision 1. April 28, 1969.
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